KPMG

Decarbonizing ground operations: A long-haul journey

Aviation 2030 series

Decarbonizing ground operations: a long-haul journey

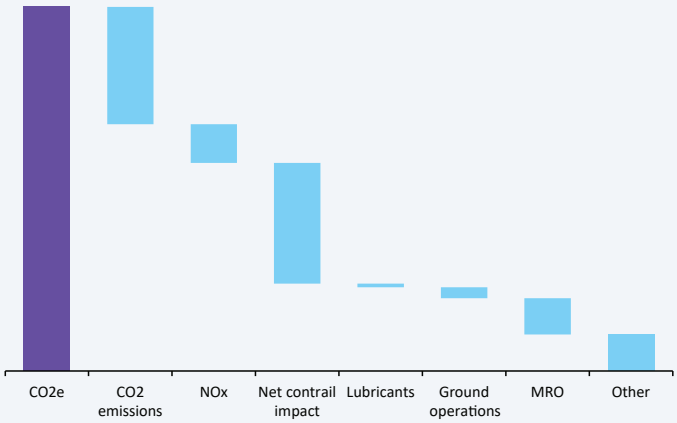
The decarbonization demands on aviation are increasingly clear, with global net zero targets cascading through all industries, however hard to achieve. Thus far, the scrutiny spotlight has fallen primarily on airlines, as the sector's primary emissions contributors, but the scale of the challenge will necessitate an industry-wide response over the projected net zero timeframes.

As abatement efforts evolve, aviation will need to move beyond the direct CO2 output from flights to other areas such as NOx, contrails, and the Landing and Take-off cycle (LTO). As key facilitators for airlines and airports, ground handling agents need to plan their response to this mission expansion. Here we set out the many opportunities we see for proactive ground handling agents (GHAs) to contribute to overall decarbonization efforts and thereby future-proof themselves in a climate of ever-climbing environmental aspirations. Clearly, there are other considerations at the airport, such as buildings emissions, that are well documented elsewhere and reasonably universal across sectors - but in this paper, we focus on the challenge, and opportunity, for below-wing ground services.

The Big Picture

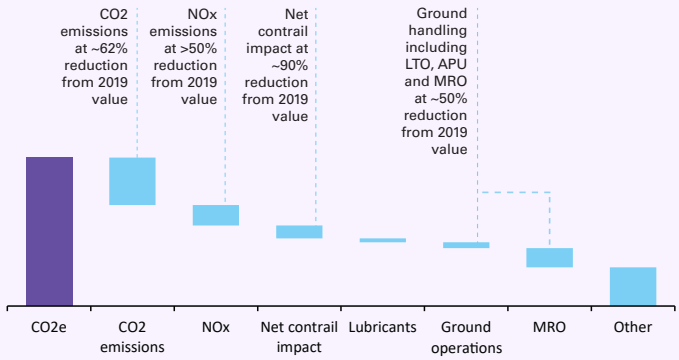
While tailpipe emissions are one of the biggest and most obvious problems for the industry, non-CO2 effects such as contrails and NOx represent around half of aviation's total climate impacts. As a consequence, managing these impacts will inevitably assume greater salience. While smaller in overall terms, ground operations – including ground handling equipment (GSE), aircraft auxiliary power units (APU) and maintenance, repair and overhaul (MRO) – will be next in line. We expect ground handling and MRO to see emission intensity reductions of roughly 50% by 2050.

Indicative CO2e contribution from aviation in 2019 (a typical long-haul Jet-A1 flight and supporting ground operations allocated)



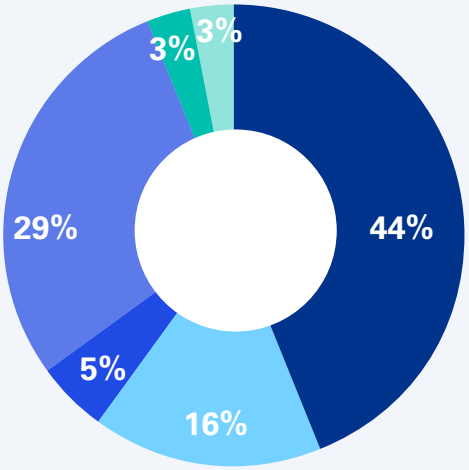
Source: KPMG analysis

Indicative CO2e contribution from aviation in 2050 (directional estimates based on a majority synthetic SAF blend flight)



Source: KPMG analysis

KPMG projected demand for (airborne) aviation energy by fuel type, 2050 (% of megajoules)



Source: KPMG analysis

This fragmentation of energy source will increase the complexity of operations for airports, ground handlers and fueling / charging activities - requiring phased investment in new infrastructure and assets - at the same time as they come under scrutiny themselves to decarbonize.

Existing powertrains

- Jet-A1
- Jet-A1 (unmet demand for SAF)
- SAF - bio
- SAF - synth

New powertrains

- Hydrogen
- Electricity

The ground handling contribution

From the airport point of view, ground handling operations account for a significant proportion of scope 1 emissions. Decarbonizing these core activities is both a challenge and – depending on timing and transparency – an opportunity for differentiation. Scope 3 emissions (primarily those from aircraft) are still more significant but represent an opportunity for innovative ground handlers. Data from Dublin airport, for instance, stated in 2019 that scope 3 emissions made up around 93% of its total carbon footprint. Within scope 3, however, a significant proportion is accounted for by the LTO cycle, GSE, shuttle buses, and APU usage, all areas where electrification opportunities exist for airports and ground handlers.

Such is the level of interdependence between stakeholders that successful airport emissions reduction over the long haul will, by definition, require the mutual facilitation of all involved players. We explore five principal areas of opportunity:

Landing and Take-off cycle (LTO)

Auxiliary power units (APU)

Electrification / propulsion system changes for ground handling (GH) vehicles

Fuelling infrastructure

4th Industrial Revolution (4IR) technologies

> The aviation sector faces a huge challenge in meeting the level of ambition implied by its global commitments

Chris Brown, Aviation Strategy, KPMG

LTO

While many airports will understandably be focused in the near term on reducing the emissions over which they have direct control, we do not expect them to limit themselves to these alone. Indeed, some airports are already committing themselves to tackle scope 3 emissions beyond 2030, which will mean focusing on the most prominent opportunity available to them: the taxi phase of the aircraft LTO cycle.

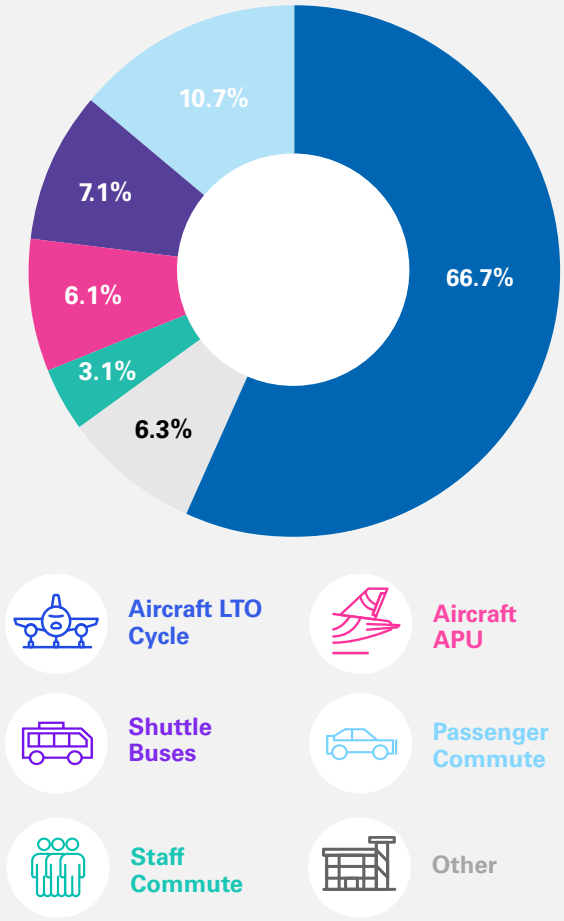
Dublin airport's figures make LTO responsible for two thirds of its scope 3 emissions, some six times higher than the next-greatest contributor. Across all airport sizes, the average figure for LTO emissions is often smaller but still the most significant single contributor.

Given airports' and airlines' relationships with the players involved in the LTO cycle, it is safe to assume that they will bring their influence to bear to sway behavior. This year, Groupe ADP appointed new GHAs at Paris Orly and Paris Charles de Gaulle as part of its decarbonization strategy, having tendered for service providers capable of operating in relevant restricted categories and delivering clean machinery, including pushback tugs[1].

Many airlines have already adopted Single-engine Taxi-in (SETI) and Single-engine Taxi-out (SETO) Standard Operating Procedures (SOPs) to address taxi-related emissions, but more will be needed. Ground handlers have a range of solutions available to them to decarbonize the LTO cycle, including electric tow tugs and charging for aircraft wheel-fixed electric motors. Innovators will see this as an area to differentiate. Laggards will wait until there is a greater push on international standards and coordination between airports. As with the decarbonization journey, GHAs will be looking to receive and give support as they size up the relevant capital investments; deployment of some electric tug designs, for instance, may require minor infrastructure upgrades to allow safe return routes. While from an airline perspective, they will want to see that alternatives are cheaper than running a single-engine at reduced power during taxi.

> **We see a significant opportunity to reduce aircraft emissions by keeping engines off during all aircraft movements near the terminal. Adding WheelTug to the airplane is like turning today's 737s and A320s into hybrid vehicles, with all the same benefits.**
>
> **Isaiah Cox, CEO, WheelTug plc**

Dublin Airport 2019 Scope 3 Emissions



Source: DAA Towards Net Zero Carbon Emissions

APU

Airports are already enforcing limitations on APU run durations to reduce emissions, air particulates, and noise. On average, aircraft APUs are responsible for 5 -10% of airport scope 3 emissions – often equivalent to the entire scope 1 and 2 emissions combined. The best prospects for reducing these emissions are offered by fixed electrical ground power (FEGP) and pre-conditioned air (PCA) at contact gates, which have the potential to make multi-factor cuts compared to APU usage, primarily if powered by renewable energy. For GHAs, ensuring that crews are accredited and capable of delivering such services will be critical. We expect airports to progressively install the relevant enabling infrastructure, and indeed are already seeing this in various locations (e.g., Phnom Penh, Mumbai, London), albeit the transition will be more challenging (but not insurmountable) where low-cost carriers (LCCs) avoid jet bridges.

[1] https://www.parisaeroport.fr/en/professionals/professional-news/groupe-adp-reaffirms-its-intention-to-decarbonise-airside-ground-operations

GSE electrification

GHAs operate a broad spectrum of airside vehicles, all of which present opportunities for emissions reductions through electrification. Some airports are already insisting on using Low Emission Vehicles (LEVs) for all possible airside operations. Several GHAs and airlines are already trialing eGSE, with buses, cargo loaders, refuelers, tugs, and belt loaders likely to be replaced by LEVs in the coming decade. Swissport has already committed to electrifying 50% of its global GSE fleet by 2025. Other recent developments have seen Air France employing retrofitted and new eGSE to handle A350s from Paris, as well as London Heathrow (LHR), Munich (MUC), and Madrid Barajas (MAD) and Barcelona El-Prat (BCN) using fully-electric towbarless aircraft pushback tractors for short haul fleets. Again, co-dependence is critical: the electrification of airport GSE requires a one-off or phased infrastructure upgrade, including transmission from the grid to the airport, on-site batteries and EV charging points. Beyond electrification, airports can reduce the need for tanker trucks through hydrant refueling infrastructure. In contrast, hydrogen-powered GSE will be more viable for airports with grid capacity constraints or certain climatic conditions.

Fueling infrastructure

The decarbonization journey for aviation will rely heavily on the transition away from Jet-A1, at first to SAF (initially bio, and then increasingly synth from the 2030s), and some hydrogen and electric (however, we project that even by 2050, supply for SAF will be less than the actual market demand). As a critical link in the refueling chain, GHAs again have an active role to play here.

With leaders such as Norway already targeting the introduction of electrified aircraft for short-haul before 2030, billions of investment dollars pouring into hydrogen and electric concepts, major manufacturers like Airbus promising zero-emissions models by the late 2030s, and numerous jurisdictions mandating SAF percentages in the immediate future, the refueling infrastructure for aviation globally is set to evolve to a state of much greater complexity. This implies more asset types and an ever-greater need for pragmatic pooling of assets. GHAs will need to respond nimbly to these developments to ensure they can act as facilitators rather than obstacles to airline and airport ambitions.

> “At regional European airports like Ostend-Bruges or Antwerp, our first step is full electrification of GSE, which should be complete mid-decade. The extent to which this requires upgrade in grid connection is highly specific, but we are working with the network provider for the necessary changes. This grid demand goes beyond GSE, however. Regional airports have an opportunity to reduce Scope 3 emissions from airlines faster than larger hubs do. Sub-20 or -50 seater regional aircraft are realistically the first to electrify and we already see one of our operators with orders placed for eCTOL, aiming for deployment from (and charging at) our airfield within the next 5 years. This also has implications for our airside fire services that will have to be trained re electric vehicles and aircraft fires.”

Eric Dumas, CEO & Accountable Manager, Ostend-Bruges and Antwerp airports

> “At daa, we are maximising the opportunity that exists now to reduce the impact of our ground fleet, and working with ground operations partners to support their needs. We see the exponential growth in electrical vehicles as the biggest challenge now, both in supplying charging infrastructure but also in ensuring that the grid capacity across our campus can support the growing demand. For larger vehicles, biofuels hold the most immediate promise, but we expect to see viable hydrogen technology within the next decade.”

Andrea Carroll, Group Head of Sustainability, daa plc

4IR tech

Technologies such as EV, AV, AI, and IoT have already started to disrupt the GSE market, allowing airports and airlines to have real-time visibility of equipment, reduce accidents, and achieve efficiencies, which translate to improved environmental (and financial) performance. Think smart chargers and the use of geolocation to minimize apron journeys, with digital solutions offering the ability to optimize APU and ground power usage based on the matrix of relevant factors such as cabin cooling needs, planned departure times, and location. 5G (FAA concerns around bandwidth interference aside) will further strengthen the use case for GPS fleet management solutions based on endpoint data capture, analysis and communication, allowing fleet managers to effectively plan asset usage over time and drive efficiencies in fuel consumption, maintenance, and minimized aircraft engine use during the LTO cycle.

Air Traffic Control modernization will continue to bring more operational efficiencies in the air. But detailed data from air traffic systems can be combined with information from other stakeholders such as airlines and airports, to provide better visibility on when an aircraft is ready to arrive or depart an aerodrome, and this will help drive ground efficiencies as GSE movements are minimized.

David Usher, Head of Customer Relations at the Irish Aviation Authority ANSP

Data Analytics & IoT solutions will likely play a key role in understanding the current carbon impact of ground operations, as well as providing a valuable means to measure the impact of decarbonization strategies. Carbon-accounting analytics technologies that can monitor and analyze of all the moving elements of the airside operation, from taxiing aircraft through to LTO to ground vehicle journey behaviors, will enable this.

Richard Vilton, CEO, Emu Analytics

Conclusion

The aviation sector faces a huge challenge to meet the ambition implied by its global commitments and will face piercing scrutiny as it seeks to meet that challenge. All segments will be required to play an active part in reducing impacts beyond aircraft tailpipe emissions, and those that do so proactively can profit from adopting a leadership position. We list some of the implications as we see them by player type:

Ground handling agents

- Proactively evaluate opportunities for GSE electrification via retrofitting, natural cycle renewal, and lease. Conduct complete lifecycle carbon footprint analysis to inform the decision on when to retire assets.
- LTO and APU solutions offer many airport emissions reduction opportunities and should be the priority for your airport partners. Hold proactive discussions with airlines and airports on the potential GHAs have to facilitate reductions in these areas, supported by appropriate airport investment decisions.
- Anticipate airline and airport aspirations for LTO and APU evolution in CAPEX decisions and staff training.

Airlines

- Making statements on your SAF aspirations is not enough. Concerns over bio SAF fuel supply are valid – don't assume supply ramp-up beyond 2035 given feedstock and food security challenges. We expect synth SAF to be the prominent alternative to Jet-A1 by 2050. However, there is a high risk of a gap between demand and supply. Biofuel will already be flatlining around 2035, and feasibility studies, therefore, need to consider the realistic lifespan of biofuel plants. Start strategic conversations with your Jet-A1 suppliers on their supply roadmap and how you can enter long-term contracts or even how you can co-invest with them (and airports regarding the necessary infrastructure) today.

- Contrails' net climate impact will come under increased scrutiny this decade; this provides relatively low-hanging fruit to reduce your net climate impact through modest route planning adjustments that reduce contrail formation.
- Back on the ground, LTO electrification should be your priority. Some solutions, like WheelTug, focus directly on the airline rather than the airport or ground handler. Whatever the technology deployed, however, this requires coordination between airports, GHAs, and even your aircraft lessor.
- Longer-term, especially for onward regional connections, the fragmentation of aircraft energy sources also means additional complexity in your supply arrangements. As your demand across Jet-A1/SAF, hydrogen and electric evolves, consider the pros and cons of specialist suppliers vs. single providers per airport.

Airports

- Partnerships with international airport federations and airport groups (e.g., ACI, Aena, Vinci, Groupe ADP) could scale the opportunity for airport decarbonization services, showing the net savings and CO2e emissions reduction potential for both airports and airlines. Partnering with a vehicle manufacturer and bundling with telematics and data management solutions could offer a competitive advantage for eTrucks.
- Electrification of airport GSE requires a one-off or phased infrastructure upgrade, including transmission from the grid to the airport, onsite batteries and EV charging points. Ensure EV charging technologies selected are suitably fast and consider the related landside opportunity for staff and passenger car parks. An upgrade could be packaged into a multi-year financial product to reduce customer hesitancy.
- The APU/FEGP opportunity is essentially there for the taking, provided airports can articulate to airlines that FEGP is a lower cost option than running APU (when fuel and per hour maintenance costs are considered).
- Many larger airports are producing renewable energy onsite already. However, this typically only covers 1-20% of current electricity needs, and this is before the demand from eGSE and electric aircraft increases that need. Solutions will often be grid-based with some viable onsite / behind-the-meter renewable projects, especially where local grid capacity is a bottleneck.

Ground handling supply chain

- Make sure you are helping ground handlers to modernize with automation, integrated IoT / data-driven decisions, not simply relying on legacy equipment offerings.
- Explore opportunities in leasing of eTrucks and other eGSE, as well as retrofitting.
- Relatively few airports beyond Europe are actively decarbonizing. We envision a suite of related services that can be selected per specific airport needs or packaged as an end-to-end solution taking an airport from initial baseline to minimized emissions (and net zero with quality offsets) – consider partnering with energy providers and consultancies to plug the required skill gaps.

Policymakers

- Current policy aspirations for SAF could be optimistic and are at risk from feedstock challenges. Policymakers can consider ways to incentivize fleet replacement to hydrogen and electric, as well as foster development of hydrogen, carbon capture technologies and even micro nuclear reactors to enable abundant production of green hydrogen and therefore also accelerated production of synth fuel.
- Consider widening the CO2 focus to CO2e, integrating the impact of NOx and contrails into existing and emerging frameworks / carbon markets.
- Consider setting clear expectations for industry around LTO and APU electrification – something that can be done relatively simply at the national level and without the need for slower international consensus.

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