Roland Berger

Green taxiing initiatives: environmental, financial, business and operational impacts

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AUTHORS

GABRIEL SCHILLACI
Partner

NIKHIL SACHDEVA
Principal

MONA BENZEKRI
Case Team Leader

Ground-level decarbonization efforts offer promising avenues to reduce airport platforms' emissions.

In the pursuit of decarbonization in the aviation industry, a multitude of groundbreaking solutions are emerging to address carbon emissions, both during flight and on the ground. While considerable attention has been devoted to reducing emissions en route, recent initiatives are targeting ground operations, also benefiting to local communities and airport personnel.

- ### Taxiing emissions can be a significant contributor to airports' carbon footprint, highlighting the importance of ground-level decarbonization.

Aviation accounts for c. 3% of global energy-related CO_2 emissions, and have grown in the last decades due to traffic increase although unit emissions per PAX tend to decrease. Among these 3%, approximately 10-15 % are attributed to airport platforms. As international travel demand recovers, following the Covid-19 pandemic, many measures are required to curb the growth of carbon emissions, among which ground-level decarbonization initiatives. They encompass a diverse array of strategies, including the transition to sustainable power sources for Ground Support Equipment (GSE) and the implementation of innovative solutions to minimize carbon footprints.

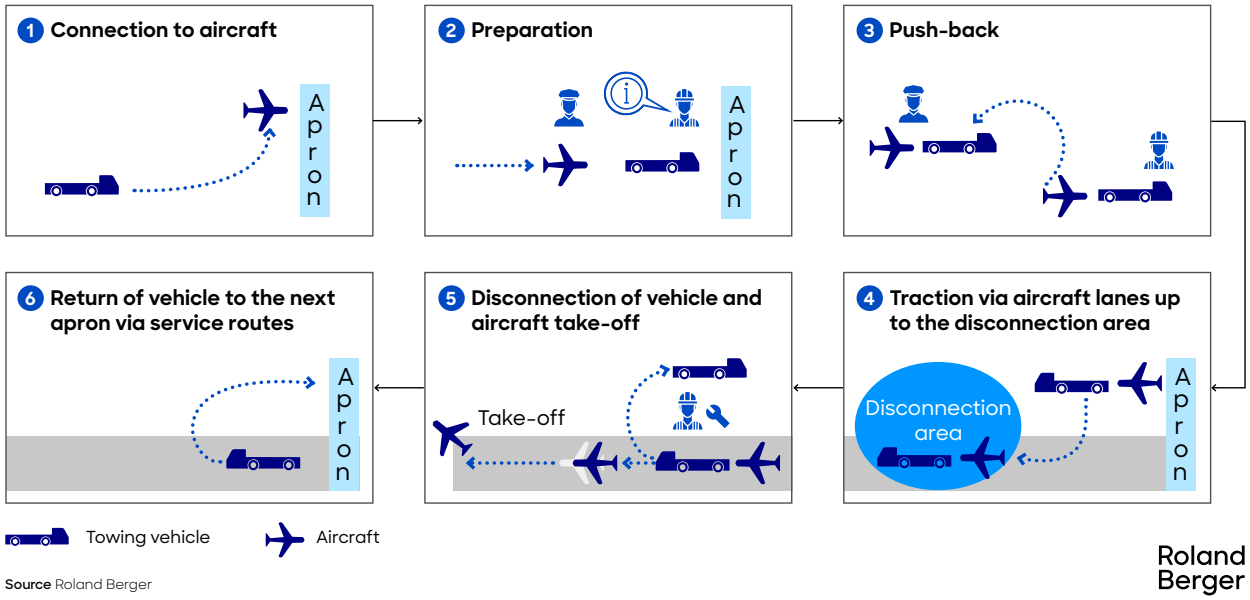
Among these strategies, the greening of GSE stands out as a pivotal step in the journey towards sustainable aviation. This transition, from reliance on diesel power to embracing electric or hydrogen-based alternatives, has been underway for some time, starting with baggage carts and gradually extending to heavier equipment such as high loaders, transporters, and pushback tractors. By reducing emissions generated during ground operations, airports can significantly mitigate their environmental impact and contribute to broader sustainability goals.

Another key aspect of ground-level decarbonization revolves around optimizing onboard systems to minimize energy consumption. By limiting the usage of onboard air conditioning and electric supply through auxiliary power units (APUs), airports can reduce emissions associated with aircraft standing, while improving overall operational efficiency and reducing noise. Furthermore, efforts are underway to connect Pre-Conditioned Air (PCA) directly from airport infrastructure to aircraft, eliminating the need for ACU or onboard air conditioning during ground operations. Similarly, connecting ground power sources, such as 400Hz or electrical Ground Power Units (e-GPUs), further reduces emissions by eliminating the need for APUs while parked at gates. However, such initiatives need strict processes to be established and applied by stakeholders - airports, airlines, ground handlers and OEMs - in order to ensure alternative measures to APU are properly used.

Emerging as a particularly promising solution, "green taxiing" initiatives are gaining traction in the aviation industry. These initiatives involve the deployment of hybrid, electric, and potentially hydrogen-powered vehicles capable of towing aircraft from gates to runways, thereby minimizing engine use during taxiing - as aircraft are then taxied with engines off. These solutions are being developed and rolled-out for both narrow-body or and wide-body aircraft.

Anticipating operational impacts

Various stages of a green taxiing procedure



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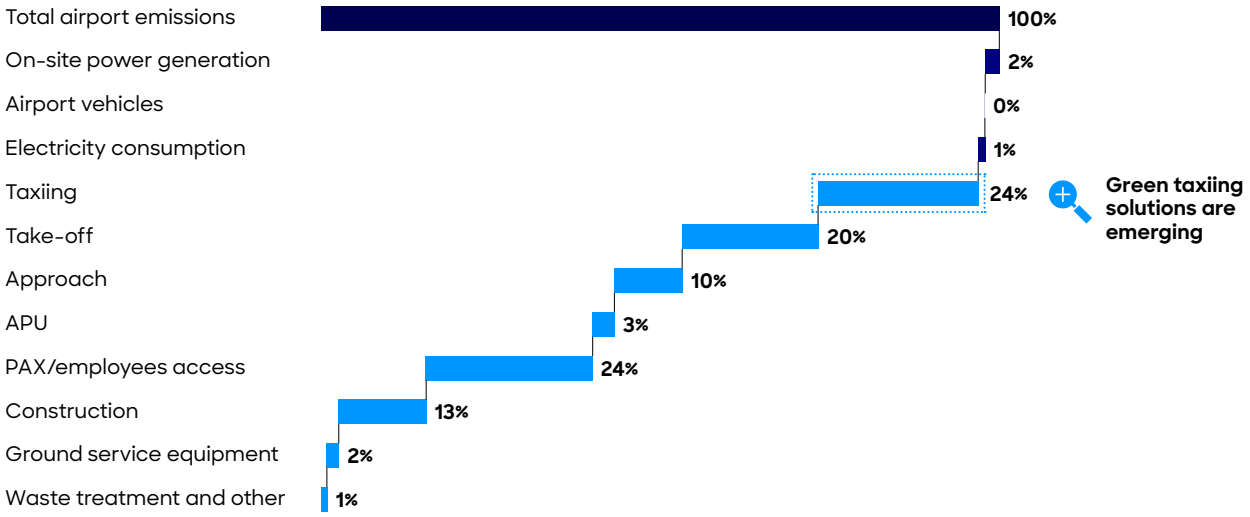
Despite the relatively small contribution of taxiing to overall emissions for airlines (typically less than 5%), the impact on airport platforms can be substantial, particularly for large hub airports where taxiing can account for up to 25% of their emissions. This underscores the significance of implementing decarbonization solutions at ground level to achieve meaningful reductions in greenhouse gas emissions and improve air quality for airport communities.

These environmental gains can vary significantly depending on the airport's existing infrastructure and airlines' standard practices, thus requiring ad hoc technical and economic assessments.

Roughly a quarter of airport emissions generated during taxiing

Airport emissions by source [Example of a large international hub ; %]



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- **Beyond their sustainability benefits, the deployment of green taxiing solutions can yield economic benefits, particularly considering the upward trends in airline costs.**

Implementing such solutions requires considering both the generated benefits and the incurred costs – factors heavily dependent on each airport platform and the cost structure of airlines and ground operators herein.

Most benefits would presumably accrue to airlines, as they stand to gain from cost savings in jet fuel (incl. the impact of a climbing share of SAF), CO_2 costs (particularly ETS for European-bound movements), avoided engine maintenance expenses, etc.

On the other hand, significant costs and investments may be necessary, both for:

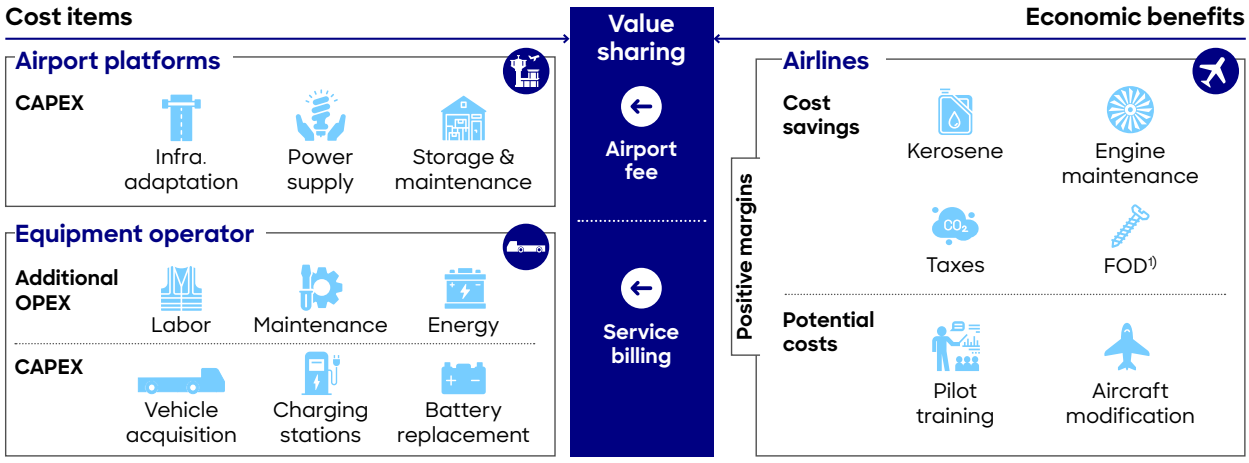
- Airport platforms, for infrastructure upgrades (e.g., adapting service routes, providing additional electrical power)

- Operators: Leasing or acquiring the vehicles, recruiting, and training an additional workforce, and mobilizing staff longer vs. traditional pushbacks.

Given the potential costliness of the equipment, the cost could initially be driven by airport platforms, to facilitate adoption, before encouraging operators and/or airlines to assume the costs. Various ecological transition financing programs can help incentivize adoption.

A necessary balance between generated margins and induced costs

Example of a financial equation



Note Foreign Object Damages
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Ultimately, the financial model should guarantee a balance between financial benefits and induced costs for all stakeholders, ensuring fair value sharing - and risks, for instance through service billing and/or airport fees.

The economic viability of these initiatives is contingent upon various factors, including infrastructure requirements, airlines single-engine practices, labor costs, and operational complexities which are unique to each airport.

- **Deciding on an adequate business model requires a detailed assessment of the risks and benefits associated with each possible option.**

Considering the diverse array of stakeholders engaged in implementing such a solution, including airports, airlines, ground handlers, and third-party entities, the potential business models are multifaceted.
The decision-making process regarding model selection, whether it pertains to vehicle acquisition, operational strategies, or maintenance protocols, demands a comprehensive assessment of its ramifications across the ecosystem. Such scrutiny ensures that every participant can extract value from the initiative.

Moreover, certain options may necessitate legal validation, contingent upon the regulatory landscape's nuances. This encompasses aspects such as compensation structures and the feasibility of deploying specific equipment types, underscoring the importance of aligning business strategies with legal parameters.

Assessing risks and rewards

Questions to address to define an adequate business model

	Vehicle acquisition	Vehicle operation	Vehicle maintenance
Airport platform	What model facilitates **equitable value distribution** among stakeholders?		
Ground handling operator	How can the airport platform **foster adoption**?		
Airline	How can the model **capitalize on existing expertise** (e.g., knowledge, established networks)?		
Third-party company (e.g. lessor)	How can **direct competition** with conventional pushback operations be circumvented?		
OEM	What constraints and opportunities does the **legal framework** present?		
	What **financial risks** exist, and how can stakeholders mitigate them?		
	Which **organizational model** is preferable (e.g., advantages and drawbacks of equipment pooling)?		
	What **remuneration schemes** and **financing avenues** can be leveraged?		

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"Ground-level decarbonization, vital for airports, requires evaluation, planning and collaboration with specific processes between stakeholders to ensure CO_2 savings are secured."

GABRIEL SCHILLACI
Partner

- **Once the environmental positive impact is proven, the financial sustainability validated and the business model approved, anticipating operational impacts is a key step to ensure a smooth deployment.**

The implementation of such solutions can entail significant operational implications that are best anticipated to effectively prepare teams for integration, for instance through ground staff and pilot training and communication protocols adaptation.

These operational impacts are numerous and include for example the allocation of a dedicated disconnection area with protocols which may vary from one airline to another, or the adjustment of air traffic control procedures with the increasing number of vehicles on the platform, in areas previously reserved for aircraft.

The business case for green taxiing solutions can be relevant for a wide array of airport platforms, particularly for large hubs with minimal infrastructure upgrade needs and prolonged taxiing durations (minimum of 5-10 minutes, including engine heating time). If a combination of high-cost jet fuel and stringent sustainability regulations are added to the mix, the viability of such solutions becomes even more compelling.

NIKHIL SACHDEVA
Principal

"Every airport should evaluate its own conditions, clientele and financials – which technologies make the most sense? Engaging with the airlines cannot be underestimated, either: bringing airlines along on the journey and helping them understand the business case is key."

Conclusion

While ground-level decarbonization solutions hold promise for reducing carbon emissions for airport platforms, their successful deployment necessitates thorough evaluation, strategic planning, and collaboration among stakeholders. By embracing innovative solutions such as green taxiing and optimizing ground operations for sustainability, airports can play a significant role in advancing their decarbonization agenda.

Further reading

- *AVIATION'S GREEN TRANSITION – THE ROLE OF MANUFACTURERS*
- *CLEARED FOR TAKEOFF*
- *ACCELERATING AIRPORT DECARBONIZATION*

CONTACT:

GABRIEL SCHILLACI Partner
gabriel.schillaci@rolandberger.com

NIKHIL SACHDEVA Principal
nikhil.sachdeva@rolandberger.com

MONA BENZEKRI Case Team Leader
mona.benzekri@rolandberger.com