

Whitepaper

**Electrification of
Ground Support
Equipment (GSE)**

*From sustainability win to electric aviation
readiness*

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Management Summary

Airports face a dual challenge: reducing their environmental impact while safeguarding a reliable, efficient operation within increasingly constrained conditions, such as grid congestion and limited airside space. In this context, the electrification of Ground Support Equipment (GSE) is increasingly seen as a logical and achievable starting point for sustainability.

This whitepaper demonstrates that electric GSE delivers direct environmental benefits while remaining well suited to daily operations. Due to its predictable usage patterns and manageable power demands, GSE electrification is also feasible at airports with limited grid connections.

Grid congestion need not be a barrier. The Pyramid of Airport Electrification frames electrification as an operational opportunity, where smart charging, local energy generation and, where needed, energy storage make it possible to decarbonise within existing grid capacity while building experience in energy management.

Future-proof investments require open choices. Open charging standards (Type 2 / CCS2 and MCS) and open protocols (OCPP and OCPI) ensure interoperability and scalability, and enable GSE charging infrastructure to evolve toward electric aviation over time. GSE electrification is also economically attractive. Lower energy and maintenance costs, combined with national, regional and European subsidies, frequently result in a favourable Total Cost of Ownership.

Finally, this whitepaper shows that charging infrastructure can grow into more than an operational facility. By developing the airport into an energy hub, new operational opportunities and potential revenue models emerge. GSE electrification thus forms a strategic foundation for further electrification and preparation for electric flight.

1. Introduction: The sustainability challenge of airports

Airports play a central role in the national and international mobility system. At the same time, they are under increasing pressure to reduce their environmental impact. This pressure does not come solely from local residents and airlines, but is increasingly driven by European climate targets, by ambitions that airports impose on themselves in the context of their social role, the creation of a healthy working environment for apron staff, and future-proofing.

Examples of airport ambitions around electric GSE in Europe

Country	Airport / Network	GSE Target	Target Year	Ranking
 Netherlands	Schiphol Group (AMS, EIN, RTM)	Emission-free ground operations (incl. GSE)	2030	★★★★★ One of the most concrete and binding targets in EU
 Spain	AENA (all Spanish airports)	Large-scale electrification of GSE	2030	★★★★★ Network-wide approach, phased rollout
 France	Groupe ADP (CDG, ORY)	Zero-emission ground ops	2030–2035	★★★★★ Strongly linked to energy infrastructure & SAF
 Germany	Fraport (Frankfurt etc.)	Emission-free GSE (scope 1 & 2)	2030	★★★★★ Strong focus on e-GSE + grid reinforcement
 Sweden	Swedavia (ARN, GOT)	Fossil-free airside incl. GSE	2025–2030	★★★★★ Europe-wide frontrunner
 Norway	Avinor	Fully emission-free airports	2030	★★★★★ GSE + electric regional aviation
 UK	Heathrow Airport	Zero-emission airside vehicles & GSE	2030	★★★ Not an EU member, but comparable ambition
 Italy	Aeroporti di Roma	Electrification of GSE	2030+	★★★ More phased, partly dependent on subsidies

At European level, the European Green Deal and the Fit-for-55 package set the direction for a substantial reduction of greenhouse gas emissions by 2030 and climate neutrality by 2050. Although these frameworks contain no explicit obligations for the electrification of Ground Support Equipment (GSE), they are increasingly translating into concrete targets at airport level. In particular, emissions from ground operations fall within the direct sphere of influence of airports and are therefore seen as a logical and achievable starting point for sustainability.

Ground first: electric GSE in practice

Within this context, the electrification of Ground Support Equipment is increasingly regarded as a realistic and effective first step toward broader sustainability on the airside. Electric GSE delivers direct reductions in CO₂, NO_x and particulate matter emissions, improves the local living environment, and aligns with both European climate targets and airport-specific net-zero ambitions.

In addition, this development enables airports to gain practical experience with electric infrastructure, energy management and operational integration. That experience forms an important foundation for subsequent steps, including further electrification of mobility and, in time, support for electric flight.



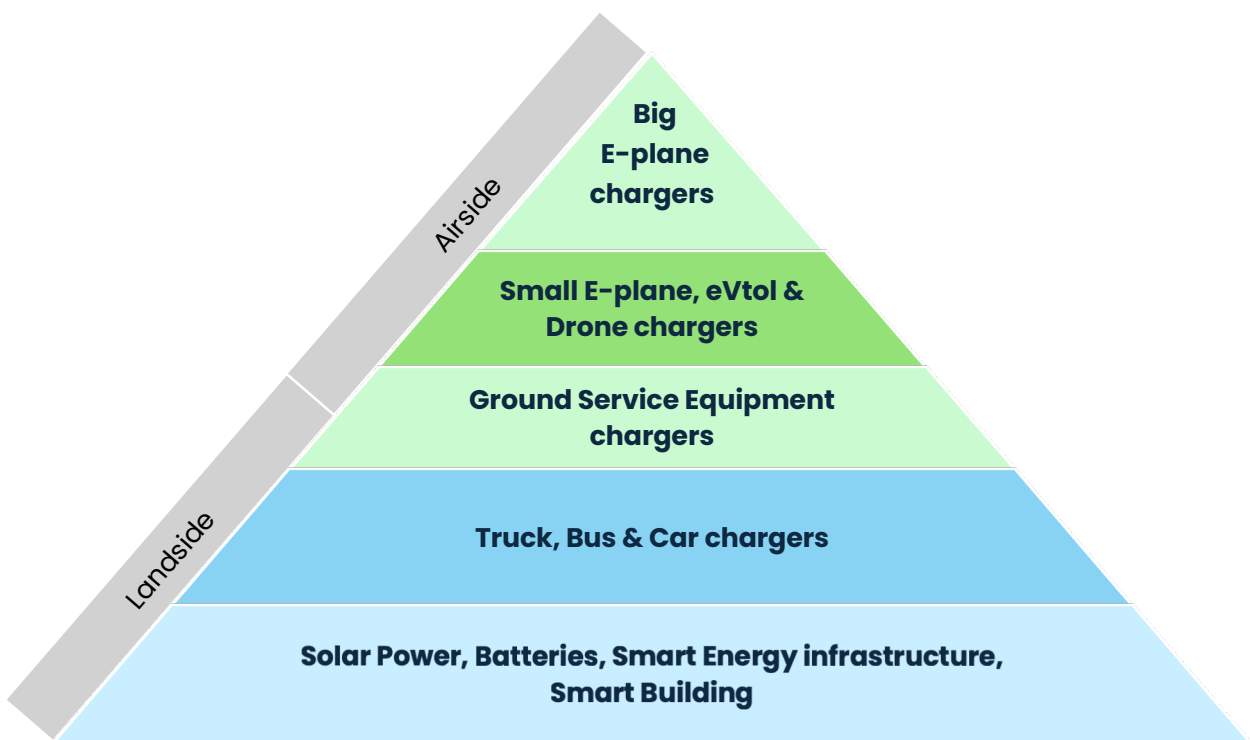
2. Electrification of GSE in relation to grid congestion and limited grid connections

Within the broader sustainability challenge facing airports, GSE electrification stands out as a measure with direct and demonstrable impact. GSE is used intensively, follows predictable deployment patterns, and operates largely within clearly defined areas of the airport site. These characteristics make GSE particularly well suited for electrification.

At the same time, many airports struggle with limited grid connections and grid congestion that makes expansion impossible. That is precisely why GSE is a logical starting point: power demands are manageable and energy consumption can be effectively controlled in terms of both timing and location.

The Pyramid of Airport Electrification frames electrification as an operational opportunity rather than a bottleneck. By combining GSE with smart charging, local energy generation and, where needed, energy storage, an airport can build experience with electric equipment and energy management step by step. The knowledge and infrastructure accumulated in this way form the foundation for subsequent steps toward electric flight: initially on a smaller scale with CCS and kW chargers, and subsequently scalable toward MCS and MW charging infrastructure.

Pyramid of Airport Electrification



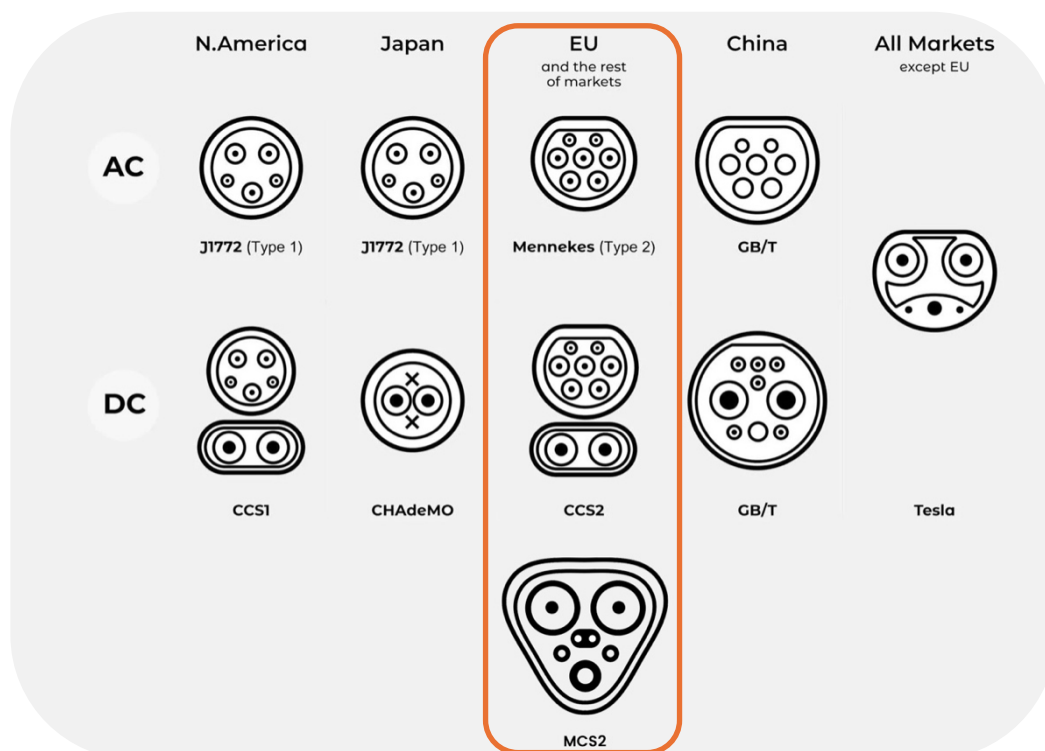
3. Standardisation and interoperability

In the aviation and energy sectors, active work is underway on the standardisation of charging protocols and connector types. This increases the interoperability of charging infrastructure and makes it possible to deploy GSE charging facilities flexibly, even with varying vehicles, suppliers and users. By choosing open and standardised solutions now, airports avoid dependency on brand-specific or non-scalable charging solutions.

Within Europe, Type 2 / CCS2 is the dominant standard for electric road transport and increasingly also in aviation. This is not only relevant for GSE, but also for the future of electric flight: within the same standard family sits MCS, designed for very high power levels. CCS2 therefore forms a logical starting point that is scalable toward MCS charging infrastructure, enabling economically viable turnaround times for larger battery-electric aircraft.

A note on charging standards: the red plug problem

A significant share of electric GSE is supplied with a red industrial plug (IEC 60309). While low-cost, this approach bypasses any smart charging ecosystem: no load management, no energy system integration, no data. All the benefits described above cease to apply. Red-plug infrastructure also cannot evolve toward the open standards required for electric aircraft charging. It is a dead end, not a foundation.



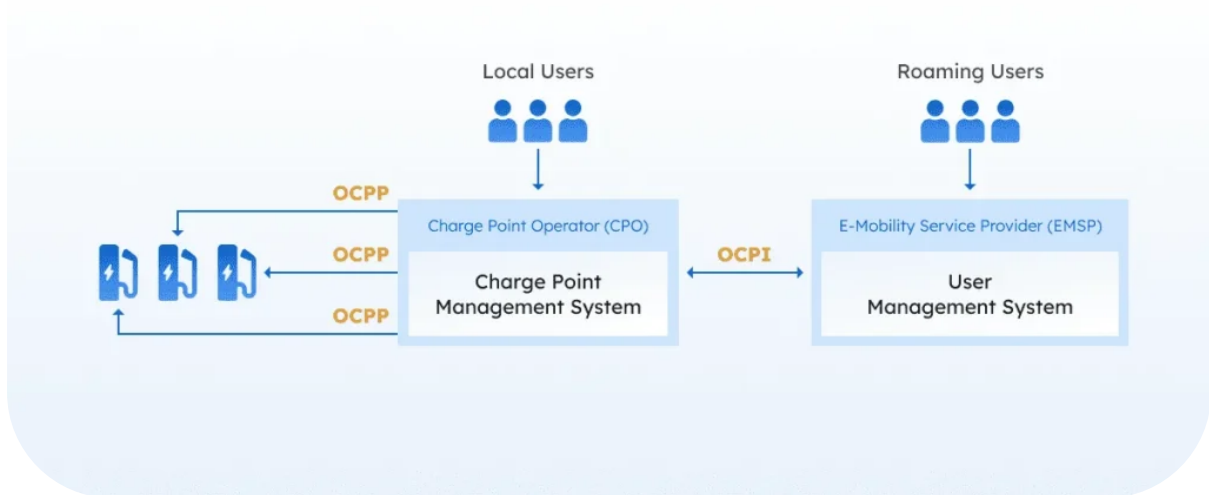
4. Open protocols as a prerequisite for scaling: OCPP & OCPI

Beyond physical standards, communication protocols are equally essential. A CPO (Charge Point Operator) platform enables the management of charging points, optimisation of energy distribution, and settlement of charging sessions. These backend systems make it possible to handle available energy in a smarter way. As such, CPO platforms enable new business models to emerge at airports that are already widely applied at business parks elsewhere in Europe. In this way, the electric GSE fleet can be charged in a less burdensome and more profitable manner on the operational airside.

A CPO platform is able to manage and control chargers intelligently using OCPP (Open Charge Point Protocol). These standardised protocols are the world's most widely used form of communication between charging stations and backend systems. OCPP handles the starting and stopping of charging sessions, provides visibility into charging point data, and enables smart control of chargers through load balancing and smart charging. This ensures that the right vehicles are always prioritised for charging, and allows an eGSE fleet manager to operate their fleet efficiently.

OCPI (Open Charge Point Interface) enables communication between different charging networks and users, making settlement, access management and roaming between parties possible. For airports with multiple handlers and external users, these open protocols are crucial for organising charging infrastructure in an efficient, scalable and future-proof way. OCPI makes it possible to link different handlers, different charging areas at an airport (landside and airside), and multiple airports within a single CPO environment.

How OCPI Works



(source: Ampeco)

For airports, this translates into a concrete recommendation: choose charging infrastructure today based on the open Type 2 / CCS2 charging standard (MCS-ready) and a CPO platform that uses established open protocols such as OCPP and OCPI, so that investments in GSE charging automatically scale alongside the growth of commercial electric aviation.

5. GSE electrification: economic benefits and subsidy instruments

From a cost perspective as well, the electrification of Ground Support Equipment is a logical and low-threshold first step for airports. Electric GSE typically has lower energy costs and significantly less maintenance than diesel-powered alternatives. Particularly for vehicles with high utilisation and long operational hours, this translates directly into structurally lower operating costs.

Machine	Battery application	Battery capacity [kWh]	Battery capacity [V/Ah]	Charging Type	Charging performance [kW]
Pushback tractor	Lithium	40	-	Type 2	8
Beltloader	Lead acid	-	80/560	Lead acid charger	30
Beltloader	Lithium	26	-	Type 2	8
Stair	Lead acid	-	80/560	Lead acid charger	30
Stair	Lithium	26	-	Type 2	8
Transporter	Lithium	100	-	CCS Type 2	75
Transporter	Lithium	100	-	Type 2	24



(Examples of E-GSE and their power ratings)

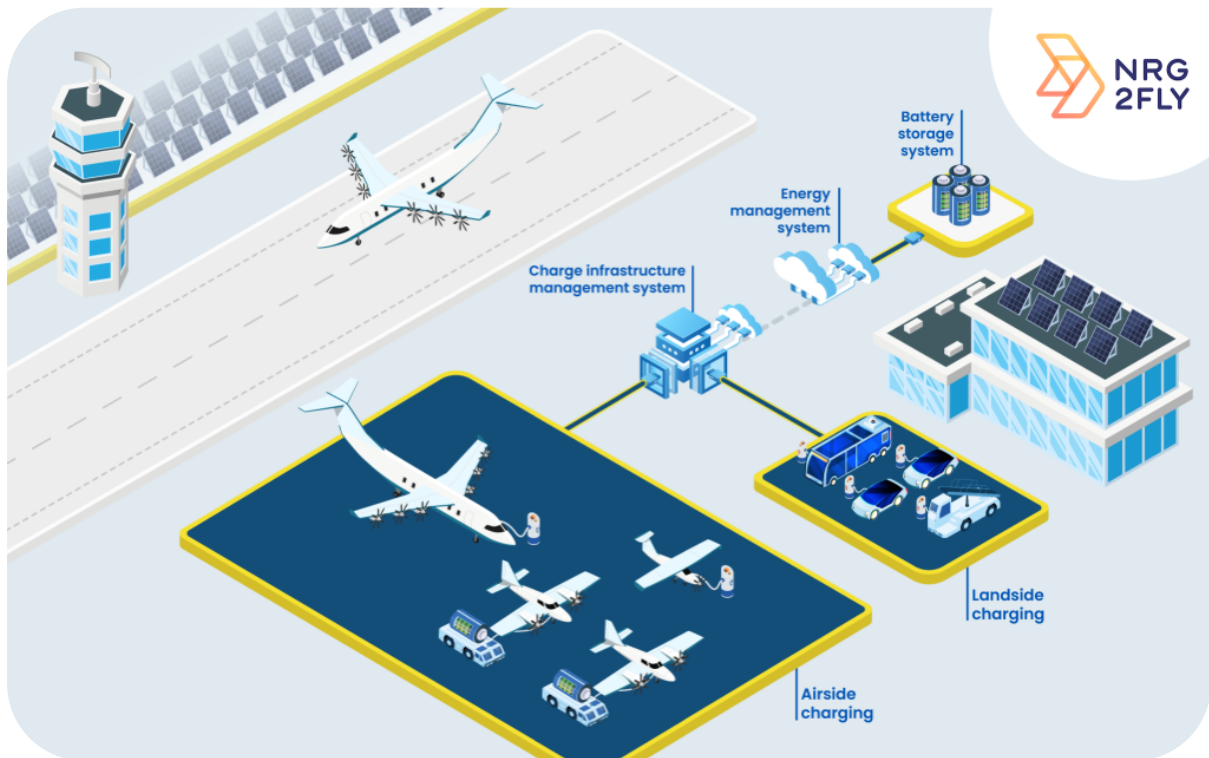
In addition, both electric GSE and associated charging infrastructure frequently qualify for subsidies and incentive schemes. In the Netherlands, these include schemes via RVO, such as subsidies for charging infrastructure and the greening of logistical assets. At the regional level, ROMs (Regional Development Agencies) can contribute through co-financing, feasibility studies or demonstration projects. At the European level, GSE electrification and smart energy solutions align well with programmes such as Horizon Europe, CEF Transport and other EU instruments targeting zero-emission mobility and energy innovation.

Combined with this support, the transition to electric can result in an attractive Total Cost of Ownership, often already within the first years of use. GSE electrification is therefore not only a sustainable investment, but also a financially rational one that directly contributes to preparation for further electrification of airside operations and, ultimately, electric flight.

6. Future-proof investments

The choices airports make today regarding charging infrastructure have a long service life and largely determine the operational flexibility of the coming decades. By accounting for expandability, interoperability and smart energy management from the outset, airports can invest in infrastructure that grows alongside further electrification of airside and landside operations.

In this context, the airport can evolve from energy consumer to energy hub, in which charging infrastructure is combined with local generation, storage and intelligent power management. This not only offers operational advantages, but also creates space for new revenue models, such as providing charging and energy services to ground handlers, external users and, in time, electric aviation.



(Example of airport as Energy Hub)

7. Conclusion

The electrification of Ground Support Equipment forms a logical and achievable starting point for airports seeking to decarbonise within the constraints of grid capacity and operational reliability. By choosing open standards, scalable charging infrastructure and smart energy management, airports lay a robust foundation for further electrification.

Within the Pyramid of Airport Electrification, this foundation grows into more than infrastructure alone: it supports the development of the airport into an energy hub, creates space for new revenue models, and clears the path for large-scale electric aviation, without compromising the safety, continuity or efficiency of operations.

Go Deeper?

Our whitepapers are starting points. If you want to go deeper – whether you're an airport planner, aircraft manufacturer, or policymaker – reach out to Jacco or Merlijn directly. We're happy to talk through the details.

Merlijn & Jacco

Directors NRG2fly

merlijn@nrg2fly.com / +31 6 15 89 65 06

jacco@nrg2fly.com / +31 6 13 25 96 89

www.nrg2fly.com

