

Transitioning airports into Green Mobility Hubs

As the process of transitioning airports into green mobility hubs often is a complex matter, it can be beneficial to divide the process into multiple phases (see Figure 1).

In the first phase, the focus must be on lowering the overall energy consumption. While energy efficiency measures are set in place, phase 2 can be initiated converting the residual energy demand to be met by renewable energy. This can be achieved through direct or indirect electrification, which will increase electricity usage at the airport but reduce demand for fossil-based energy in other areas, such as natural gas consumption.

Given the anticipated high level of electrification across airport operations, substantial volumes of renewable electricity will be essential to meaningfully reduce CO₂ emissions. As such, strategic and integrated energy planning is critical, introduced as phase 3. To make the most of cross-sectoral synergies and ensure system efficiency, the implementation of a smart energy management system is strongly recommended. This will require comprehensive live data collection and real-time system monitoring to support intelligent decision-making.

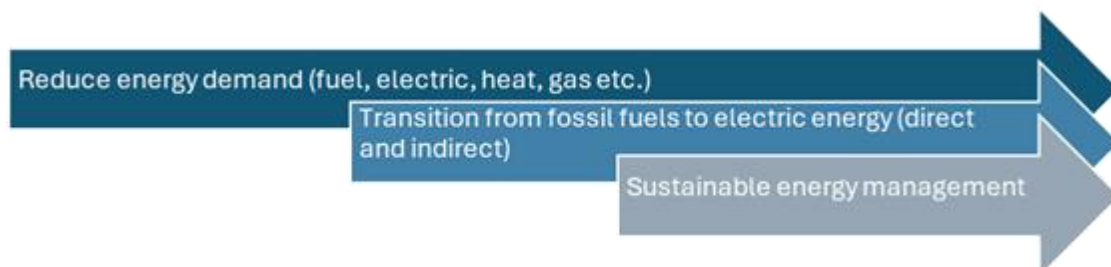


Figure 1: Structure for airports transitioning to green mobility hubs with three parallel progressing phases

Frameworks such as the ACA program offer valuable support by setting clear standards and incentives for carbon management. Additionally, targeted incentives for smart energy solutions can further encourage the adoption of innovative technologies and practices.

Phase 1: Reduce energy demand

Prioritising energy efficiency an essential *before* electrification is essential. Electrifying inefficient systems simply perpetuates the problem. The key areas are, firstly, energy efficiency measures for buildings and secondly logistics and use of ground support equipment (GSEs).

Energy efficiency of buildings shall be prioritised as a precursor to electrification, emphasising that reducing consumption is generally more economically viable before

integrating renewable energy sources (RES). This principle is illustrated with practical examples such as transitioning to LED lighting, upgrading HVAC systems, and enhancing building insulation. These measures not only reduce energy use but also lower operational costs and emissions.

In order to be able to reduce energy consumption, insight into the current operation using data is pivotal, as data can assist to identify areas of action.

Insights into current operations through data analysis is essential. Real-time historical energy data helps identify inefficiencies and target areas for improvement.

CASES

Within ALIGHT, the participating airports have already implemented impactful measures. LTOU replaced all runway and exterior lights with LEDs, resulting in a yearly CO₂ reduction of 32 tonnes. Similarly, CPH replaced apron lighting with LEDs and integrated it into the building management system, saving energy and cutting approximately 42 tonnes of CO₂ annually. LTOU also constructed a new taxiway, reducing taxiing time by approximately two minutes per aircraft, thus lowering fuel consumption and emissions.

Phase 2: Transition from fossil fuels to electric energy

When the energy demands have been reduced and made more efficient, the residual should be transitioned from fossil fuels to electricity from renewable sources. This is key to lowering scope 2 emissions (indirect emissions from energy supply). As heating, cooling, and transport systems electrify, total electricity demand will increase significantly.

As different systems in the airport (such as heating, cooling, and transportation) become electrified, electricity demand in airports rises significantly. Therefore, the usage of electricity must be monitored in order to plan the consumption and eventually made more efficient. A key strategy for smarter energy use involves controllable consuming units, like heat pumps, where the energy consumption can be adjusted based on the availability of renewable energy sources or to reduce the carbon footprint. Dynamic data can provide real-time insights into energy consumption and production and thereby enable opportunities for smart energy management. This data is crucial not only for immediate adjustments but also for long-term planning.

For instance, switching from fossil-based heat supply to heat pumps (combined thermal storage) significantly reduces emissions. Likewise, converting GSEs, buses, and other airport vehicles to electric or alternative fuels supports both decarbonisation and local air quality improvements.

CASES

Within ALIGHT work has been done to accelerate electrification of CPH, through the electrification of its GSEs fleet, where a specific planning tool has been developed to create a plan for the transition. This takes into account the type, age and role of equipment. Further, CPH has purchased electric busses for passenger transport to the terminals on landside to replace the existing conventional busses in 2025. Regarding the transition of two of CPH most used terminal busses to electric (operation will take place in 2025), it is expected to reduce 80.000 Litres of diesel annually, corresponding to approximately 215 tonnes CO₂. Within LTOU eight electric Ground Power Units (GPU) have been bought in 2024 to replace diesel driven GPUs. This project reduced consumption of diesel fuel in equipment and contributed to 209 t reduction in carbon dioxide emissions (7% of total CO₂). Moreover, LTOU is currently in the process of acquiring electric buses. The aim of the project is to purchase environmentally friendly and passenger-friendly passenger buses for airport operations to ensure uninterrupted airport operations and passenger service. It is estimated that switching from diesel buses to electric ones will reduce CO₂ emissions by at least 58,000 kg per year. Moreover, LTOU are planning to buy electric busses and built the needed charging infrastructure. Also, at CPH, the taxi management system has been upgraded with a points-based system that prioritises electric taxis. This system allows electric taxis to park closer to the terminals and grants them preferential access within the airport area. The system is supported by a database containing information on registered taxis and drivers, automatic license-plate recognition, and demand forecasting.

Further, when a large part of the energy consumption at the airport becomes dependent on electricity, access to renewable electricity is crucial. The airports should therefore investigate the possibility of having locally produced electricity e.g., through new energy projects. By prioritising local energy production, the airports take full responsibility for their own energy consumption and reduce the need for transport of electricity (transmission and distribution). At the same time their dependence on the public grid and supply is reduced, which increases the airports' security of supply and makes them more resilient to fluctuating energy prices. The airports should also ensure and prioritise the purchase of green electricity from the electricity grid e.g., through Power Purchase Agreements. By implementing and prioritising renewable energy production it will result in a reduction of CO₂ emissions for the airport.

CASE

CPH has installed local Photovoltaic (PV) plants covering approximately 4.5% of the total electricity consumption (own and tenants) and signed a PPA with two Danish wind farms for the remaining electricity consumption.

Moreover, energy storage systems enable the opportunity to fully utilise the renewable energy production, as it can be charged at times where renewable energy is in abundance and the price is low and can be discharged when renewable energy production is limited. Furthermore, energy storage systems have the potential to

reduce peak demand and thereby reducing the need for electricity infrastructure, like transformers and cables.

To fully utilise the flexibility potential of controllable consumers and energy storage systems in combination with renewable generation it is necessary to implement a smart energy management system. The management system can strategically take into account, timed grid electricity uptake during periods of low CO₂ intensity.

Phase 3: Sustainable energy management

As the transition of energy consumption in airports must not only address current energy needs but also be flexible enough to accommodate future development. This calls for strategic, long-term energy planning. Key priorities include ensuring that the capacity of battery storage systems are scalable and that energy renovation of airport buildings is carried out to support greater efficiency and future integration of renewable technologies.

Furthermore, the airport should prioritize planning of internal infrastructure to keep up with technological developments and thereby support new sustainable solutions such as electric and hydrogen-powered aircraft.

Effective energy planning can support decision-makers in their decision-making processes to choose solutions and technologies that meet both current and future requirements, even if they involve higher upfront costs, newer technologies, or additional training. For instance, Vehicle-to-Grid (V2G) systems may involve higher upfront costs for compatible chargers and vehicles compared to standard electric options.

Moreover, sustainable energy planning helps ensure alignment with broader climate goals by targeting reductions across all emissions scopes. Scope 1 and 2 emissions can be reduced by transitioning the energy supply for the airport's direct and indirect energy consumption as described previously, while Scope 3 emissions, those associated with tenants, airlines, passengers, passenger transportation to and from the airport, and other downstream activities, require broader coordination and collaboration. Within the ALIGHT consortium, emissions from passenger transport are calculated based on ongoing passenger surveys conducted throughout the year.